U.S. Department
of Transportation
**Federal Aviation
Administration**

STANDBY POWER FOR NON-FAA AIRPORT LIGHTING SYSTEMS

AC: 150/5340-17B
Date: 1/6/86

Advisory Circular

U.S. Department of Transportation
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Subject: STANDBY POWER FOR NON-FAA AIRPORT LIGHTING SYSTEMS

Date: 1/6/86
Initiated by: AAS-200

AC No: 150/5340-17B
Change:

1. PURPOSE. This advisory circular (AC) describes standards for the design, installation, and maintenance of standby power for non-agency owned airport visual aids associated with the National Airspace System (NAS) and the national system of airports.

2. CANCELLATION. AC 150/5340-17A, Standby Power for Non-FAA Airport Lighting Systems, dated March 19, 1971, is cancelled.

Leonard E. Mudd
LEONARD E. MUDD
Director, Office of Airport Standards

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1. BACKGROUND. Agency policy requires that visual aids associated with facilities in the National Airspace System (NAS) and the national system of airports have a definite configuration for electrical power. This advisory circular contains electrical power details acceptable for nonagency owned lighting aids and agency owned facilities associated with these systems.

2. DEFINITIONS.

   a. "Prime Power Source" denotes the normally available supply of electrical power. This is power furnished by a utility company, the military, other Government agencies, or an agency prime power plant.

   b. "Emergency Power Unit(s)" denotes any self-contained device, (e.g., engine generator, battery backup, thermo-electric device, etc.) from which electrical power can be obtained upon failure of the prime power source.

   c. "Alternate Prime Power Source" is of the type described in paragraph a above and is a system substantially separate from the first source in that it is arranged so that any single equipment failure, accident, lightning strike, or damage which interrupts power from the first source will not normally interrupt power from the second source.

   d. "Quality of Power" denotes the availability of useable electrical power. A power interruption, or a variation of voltage or frequency outside the standards set for the facility will degrade the quality of power for the facility.

   e. "Continuous Power Facility" is a facility so designated herein and provided with the quality of power required to assure that the facility's services continue to meet operational requirements even in the event of an extended widespread loss of commercial power. Continuous power facilities shall have power Configuration "A", as specified in paragraph 4a(1). See Appendix 1 for a listing of continuous power airports.

   f. "Continuous Power Airport" is an airport equipped with an emergency power unit(s) which will provide the power required for facilities on the selected runway to sustain operations in VFR or IFR conditions in the event of an area-wide or catastrophic type prime power failure.

   g. "Uninterruptible Power" is Configuration "A" power augmented, as necessary, with a device which will assure that power to the load

is not interrupted during the 15 second transfer time allowed for Configuration "A".

3. FAA POLICY. Policy requirements are contained in Order 6030.20A. The power systems for NAS facilities shall be of quality sufficient for:

   a. Safety of aircraft movement.

   b. Efficient air traffic operations.

   c. Meeting requirements of national defense.

   d. Minimizing inconvenience and cost to the aviation community.

4. ELECTRICAL POWER CONFIGURATIONS.

   a. Basic Configurations. The minimum quality of power needed at a facility varies with the effect that an outage of the facility would have on the provisions of paragraph 3. The exact relationship of an individual facility to its environment is of course, unique; but each type of facility (e.g., high intensity runway lights, centerline lights, etc.) has been evaluated for criticalness in the NAS. The evaluation resulted in the development of the configurations listed below:

      (1) Configuration "A". This configuration shall provide facilities with power from an emergency power unit within 15 seconds after failure of the prime power source, except those Category II lighting aids (listed in paragraph 4a(2)) requiring a one-second transfer. Details concerning Category II operation are contained in Advisory Circular 120-29, Criteria for Approving Category I and Category II Landing Minima for FAR 121 Operators. The system shall consist of:

         (a) Connection to a prime power source.

         (b) Emergency power unit(s).

         (c) Automatic transfer capability.

      (2) Configuration "B". This configuration shall provide facilities with power from an alternate prime power source within 15 seconds after failure of the prime power source except those Category II lighting aids requiring a one-second transfer. These are Category II high intensity runway lights, centerline lights, and touchdown zone lights. The system shall consist of:

(a) Connection to a prime power source.

(b) Connection to an alternate prime power source.

(c) Automatic transfer capability.

(3) Configuration "C". Configuration "C" provides connections of the facility to a single power source. There are no provisions for alternate prime power or engine generator sets. All lighting aids not covered in Configurations "A" and "B" are in Configuration "C". Even though standby power is not required for Configuration "C", a higher grade configuration of power is encouraged for airport lighting systems where a second source can be provided at a reasonable cost.

b. COMBINED CONFIGURATIONS. Systems having two sources of power (Configuration "A" and "B") shall be designed so the second source will be available to the facility within 15 seconds after interruption of the prime power, except that the essential visual aids for Category II operations require a one-second changeover time. Where the second source of power is an engine generator, the one-second changeover time may be obtained by powering the visual aid facility by the engine generator during Category II operations using commercial power as the second source (standby). Failure of the engine generator plant is monitored by safety devices which automatically transfer the facility load to commercial power in a nominal one-second changeover time. After prime power is restored and stabilized, the facility shall be automatically returned to the prime power supply, except where operational policy directs otherwise.

5. DESIGN. Design power systems at all facilities to meet the requirements of the applicable electrical codes. The detailed design requirements for the systems in this advisory circular are flexible to permit the equipment to be installed and operated with minimum changes to the power distribution system at the airport.

a. Configuration "A" Power. (See Figure 1A, Appendix 2, for configuration.)

(1) KVA Requirements. Prior to the selection of standby power equipment, determine the kilovolt ampere (KVA) input to the regulator. Specification values may be used for this purpose.

If qualified personnel are used and the proper equipment is available, the actual input requirements may be determined by the following method:

(a) Set the regulator to supply maximum output current.

(b) Energize the regulator with the lighting load connected.

(c) Measure the volts and amperes at the regulator's input terminals. Only QUALIFIED PERSONNEL should make the measurements at the high voltage input of the regulator.

(d) Calculate the input KVA by multiplying the measured volts times the measured amperes and dividing by 1,000. Normally, the measured KVA input to the regulator is less than the calculated KVA input. This difference is caused by the regulators having higher efficiencies and power factors than those contained in the specification.

(e) If the regulator does not have rated load connected to the output circuit, calculate the KVA input to the regulator with rated load connected. This can be calculated by dividing the rated kilowatts (KW) of the regulator by the regulator's efficiency and power factor. Typical calculations are shown in figure 2, Appendix 2, page 3.

(2) Power and Control.

(a) Design the system to provide an automatic changeover from the prime power to the engine generator equipment within 15-seconds after a power failure occurs. The detailed design requirement for the installation may vary to conform with local conditions, but no variations are permitted in the system's performance requirements. Additional details are contained in paragraph 4b and in figure 3, Appendix 2, page 4.

(b) If the engine generator set is not designed to operate continuously under a no-load condition, provide a relay or some other protective device as shown in figure 3. This relay prevents the engine generator set from operating under a no-load condition in case a power failure occurs when the regulator's remote control switch is in the off position. This is accomplished by by-passing the control switch used to control on-off operation of the regulator.

The operation of the engine generators continuously under a no-load condition can affect the equipment's performance.

(3) Space and Ventilation. Provide adequate space and ventilation for the engine generator equipment. The required space, ventilation, and engine exhaust provisions will be controlled by the KVA rating of the engine generator, the design characteristics of the equipment, and the space required to maintain the engine generator set and its auxiliary equipment. The engine generator should be located as close as practical to the constant current regulator it is serving. Typical equipment lay-out and floor spaces are shown in figure 4, Appendix 2, page 5.

b. Configuration "B" Power.

(1) Connection Requirements. Obtain connections for this configuration with one of the methods listed below. See figures 1B and 5, in Appendix 2, for typical electrical diagrams and connection details.

(2) Dual Feeders. Separate feeders to the extent that electrical malfunction or physical damage is unlikely to result in outage of both.

c. Configuration "C" Power. This configuration has no provisions for standby power; however, Configuration "A" or "B" is encouraged for all visual aids where it can be provided at a reasonable cost.

d. Category II Runway. Provide a one-second power transfer for runway centerline lights, touchdown zone lights, and high intensity runway edge lights on Category II runways. Methods of obtaining this one-second transfer are contained in paragraph 4b. At Category II locations with an engine generator set, use a remote controlled switch on the L-821 control panel to start the standby power when Category II weather is approaching. Provide a red indicator light on the L-821 panel to indicate "standby on" when the engine generator is running. The use of this remote controlled switch is an interim procedure until the agency develops and perfects equipment that will interface with the runway visual range (RVR) readout equipment and automatically start engine generators. If the Category II runway has Configuration "B" power, use automatic transfer switches designed for a one-second or less transfer.

e. Emergency Lighting. An adequate number of battery-powered emergency lights should be available at all lighted

airports for emergency use. Commercially available equipment has design characteristics acceptable for local application under emergency conditions.

f. Maintenance Controls. Provide means in the system whereby the maintenance personnel can lock out control switches in order to avoid the equipment being turned on while maintenance personnel are working on the engine generator equipment.

g. Terminal System Integrity. Recognizing that both Federal Aviation Administration (FAA) facilities and those owned by the airport sponsor must be operational to provide basic landing minimums during a power failure, FAA will not upgrade power to existing facilities, unless the associated airport-owned facilities conform to the applicable provisions of Order 6030.20, **current edition.**

6. EQUIPMENT AND MATERIAL.

a. Engine Generator Set. Unless otherwise specified, select engine generator equipment designed to meet the applicable industry standards and code requirements. When the engine generator is supplying power to FAA facilities, the engine generator unit must meet the requirements of Specification FAA-E-2204, **current edition.**

(1) General Requirement. Provide an engine generator set, for installation in a shelter, that is automatic, quick starting, and capable of carrying rated load at all ambient temperatures between 20°F. and 120°F. For temperatures below 20°F., an alternate to supplement shelter heat is a jack water heater (immersion heater). Standby equipment is required to carry rated load within 15 seconds after a power failure. The output voltage of the generator is a value acceptable for connection to the input and control circuit of regulators. **Generators required for operation of regulators have a step-up transformer, if required, between the regulators and the generator. Adequate voltage is furnished for the regulator's control circuits. The output frequency of the generator is 60 hertz, plus or minus commercially acceptable tolerances. Additional details concerning the engine generator set are contained in Appendix 3.**

(2) Exhaust System. Provide exhaust silencers (mufflers) and pipes as required for the particular installation. The exhaust pipes, when required, are black steel in accordance with **American Society for Testing and Materials (ASTM) Specification A-53, Type F, Grade A.**

(3) Batteries. Provide batteries that have a terminal voltage suitable for starting the engine generator and a minimum watt hour rating as specified in Specification FAA-E-2204. Provide racks for the batteries as required.

(4) Battery Charger. Provide a battery charger with the generator set to assure reliable service from the standby equipment. Unless otherwise specified, battery chargers meet the requirements of Specification FAA-E-2204.

b. Transformer. Provide, if required, a step-up transformer to make the output voltage of the engine generator set compatible with the input voltage to the regulator. Transformers may also be used to step down primary power and permit the use of low voltage automatic transfer switches and to supply control circuits. Select commercial equipment conforming to the applicable industry and electrical standards. Select a transformer rated to supply the required input KVA to the equipment continuously without the transformer overheating.

c. Fuel Storage Tank.

(1) Provide the fuel storage tank with a fuel gauge for the engine generator set. Select a tank with capacity adequate to provide reliable operation for the minimum period of time established by usage of the standby equipment and servicing facilities. If no emergency operating periods are established locally, provide adequate fuel tank capacity for at least 24 hours continuous operation. When selecting a particular size, consider the time required to replenish the fuel supply, the availability of fuel, the accessibility of fuel under adverse weather conditions, fuel required for maintenance test runs (paragraph 10c), and the frequency of maintenance inspections of the fuel tank and supply.

(2) Select a fuel tank that meets the requirements of the National Fire Protection Association (NFPA) and local codes. Provide fuel lines from the engine generator set to the tank as required by the equipment's design. Provide an auxiliary tank (day tank) and a transfer pump as required. Storage and auxiliary tanks should be vented in accordance with NFPA code.

(3) A typical fuel consumption for a diesel engine driven generator set is 2.5 gallons per kilowatt per 24-hour time period at

rated load. A typical fuel consumption for a gasoline engine driven generator set is 4.0 gallons per kilowatt per 24-hour time period at rated load.

d. Mounting Pads. If required, provide a mounting pad (foundation) for the engine generator set in accordance with the manufacturer's instructions and the plans for the installation. If required, provide resilient or shock mounts or isolated base to control vibration and noise.

e. Conduit and Wiring. Provide all conduit and wiring in the vault or engine generator shelter in accordance with the requirement of the National Electrical Code and local codes.

f. Radiator Air Duct. Provide, if required, an air duct from the engine radiator to a wall opening. The air intake should be adequate for proper operation and cooling of the equipment.

g. Switchboard.

(1) Provide a switchboard with the engine generator set. This equipment has provisions to switch the regulator's input from the prime power source to the standby engine generator within the required time interval after power failure is detected. Use at least a voltage sensing device to detect a power failure. When prime power is restored, the input to the regulator is switched from the standby power source to the prime power source. The automatic transfer switch meets the performance requirements of FAA-E-2204. This type of automatic switch used with the engine generator is acceptable for Configuration "B" installations.

(2) The switchboard should include safety devices consisting of low oil cutout, high temperature cutout, overcrank cutout, and overspeed cutout. The switchboard should also include indicators such as a voltmeter, ammeter, oil pressure indicator, and water temperature indicator.

(3) Provide a bypass switch as indicated in figure 3 to permit running the engine generator on manual start-stop to facilitate servicing. The bypass switch meets the requirements of FAA-E-2083, current edition.

7. INSTALLATION.

a. Configuration "A".

(1) Engine Generator Set and Accessories. Install the engine generator and its accessories in accordance with the manufacturer's instructions and the plans for the installation. The completed installation should meet all requirements of the National Electrical Code and local codes. A typical installation is shown in figure 4.

(a) Air Intake. Provide access to an adequate quantity of air for the intake of the engine generator. A typical air intake system is shown in figure 4. A wind baffle fence or other suitable provision may be installed to reduce the back pressure imposed on the engine generator.

(b) Exhaust System.

1 Support the exhaust pipe when it is installed through a wall. Where metal plates or metal sleeves are required, use a layer or layers of fireproof vibration absorbent material conforming to ASTM Specification C-892. This material is at least 1/8-inch thick. If the exhaust piping and muffler are not protected, paint them with heat resistant aluminum paint conforming to Federal Specification TT-P-28.

2 When the exhaust pipe terminates in a vertical direction, install an exhaust pipe rain cap unless otherwise specified.

(c) Batteries, Battery Charger, and Battery Rack. Install the batteries, battery charger, and battery rack at the location indicated in the plans for the installation. Place the electrolyte in the battery cells after the batteries are in their final position.

(2) Fuel Storage Tank and Lines. Install the fuel storage tank and lines and auxiliary tank (day tank) in accordance with the equipment manufacturer's instructions, NFPA code, and local code requirements. Locate the tanks at the place indicated in the plans.

(3) Transformer. Install the step-up transformer at the location indicated in the plans. Make connections to the transformer in

accordance with the equipment manufacturer's instructions.

(4) Mounting Pads. Install the mounting pad at the location indicated in the plans. The size and construction of the pad are as specified in the plans for the installation.

(5) Switchboard. Install the switchboard at the location indicated in the plans. A typical location of this equipment is shown in figure 4. The installation shall meet all applicable code requirements.

(6) Conduit and Wiring. Install conduit and wiring in accordance with the National Electrical Code and local code requirements.

b. Configuration "B". The Configuration "B" power for non-FAA airport lighting systems is normally installed by the utility company(s); however, assurance should be obtained that the installation will meet the configuration and design requirements of paragraphs 4b and 5b, respectively.

c. Configuration "C". There are no provisions for the installation of standby power with this configuration. However, Configuration "A" or "B" is encouraged for all visual aids where it can be provided at a reasonable cost. See Figure 6 for a typical electrical layout.

8. INSPECTION.

a. System. Check the electrical configuration of the system to determine if the design requirements of this advisory circular are applied.

b. Engine Generator Set.

(1) Inspect the engine generator set and its accessories to obtain assurance that the equipment is installed in accordance with the equipment manufacturer's instructions.

(2) Check the mounting of the engine and generator to determine if the equipment is securely mounted.

(3) Check all pipes, conduits, and accessories to determine if each item is securely fastened.

(4) Check all wiring to determine if it is correct and that all connections are secure.

c. Fuel Storage Tank and Line. Inspect the fuel storage tank, auxiliary tank (day tank), and lines to determine if the equipment is properly installed and that there are no fuel leaks.

d. Batteries. Check all connections to determine if they are secure and that the electrolyte in the battery cells is at the proper level.

e. Output Voltage. Check the output from the engine generator set to determine if the voltage is adequate for the regulator's input power and control circuits. Make this check prior to connecting the regulator to the engine generator set.

9. TESTS.

a. Engine Generator Set and Switchboard.

(1) Conduct tests recommended in the manufacturer's instructions.

(2) Test the installation by operating the system continuously for at least one hour. In addition, simulate at least 10 power failures and check the starting time of the engine generator equipment. Check the operation of all safety and indicating devices specified in paragraph 6g.

(3) Test the operation of the bypass switch.

(4) Test the operation of components used to obtain an automatic transfer of power from the prime source to the standby equipment.

b. Batteries. Test the batteries to determine if the specific gravity is within the range recommended by the manufacturer.

10. MAINTENANCE.

a. General. The equipment manufacturers issue specific instructions for their engine generator equipment. These instructions contain information obtained through experience and they are provided to assure reliable and efficient service from the equipment. In view of this, the instructions should be read, understood, and followed. Only qualified personnel should be allowed to maintain the engine generator set and its accessories.

b. Engine Generator Set. Perform preventive maintenance on the engine generator set in accordance with equipment manufacturers' instructions.

c. Operational Check. Unless otherwise specified, make a weekly operational check of the engine generator and associated equipment by operating the emergency system for one hour minimum, while it is supplying power to the lighting systems, preferably at maximum brightness. Since the engine generator feeds the lighting system rather than a load bank, coordinate all operational checks with tower personnel.

d. Vault or Shelter. Keep the enclosure housing, the engine generator set, and its accessories, clean and uncluttered to prevent dirt from accumulating in control compartments and to allow equipment to be accessible at all times. Mount legible warning signs in conspicuous locations.

e. Tank and Fuel Line. Check fuel tank covers and fuel line after each refueling to determine that these components are secure and that there are no fuel leaks.

f. Spare Parts. Stock adequate spare parts for miantenance purposes. Use the manufacturer's instructions as a guide concerning maintenance spares.

g. Log. Keep of log of engine generator operating hours (or provide an elapsed time meter) and a record of maintenance work performed on the equipment.

h. Fuel Supply. Establish a regular schedule for checking fuel supply. The regularity should be established on the basis of the type facility, location of the engine generator sets, and location of fuel supply. For example, thought must be given those locations where near Category II minimums exist for several days at a time.

11. REDUCING ELECTRICAL POWER INTERRUPTIONS. The sections of Order 6950.11A, pertaining to non-FAA airport lighting systems, are applicable to this circular.

a. Outages.

(1) Excessive facility outage time and preventable interruptions to electrical power service have occurred at many locations due to failure or malfunction of electrical distribution systems, standby power equipment, and power and control cables. These failures have often been compounded by a lack of system familiarity of on-duty personnel. Other power interruptions and instances of unacceptable facility outage time have been

caused by the unavailability of qualified technical maintenance personnel who could rapidly diagnose the cause of an electrical power failure and take quick corrective action to restore service. Some failures have been due to power system deficiencies not previously recognized or reported. Delays in restoration of power service have often been caused by lack of updated "as-built" drawings which correctly depict electrical distribution systems, switching equipment, emergency power equipment, and cable routing associated with the affected facility. Other delays in restoration of service have been due to time involved for maintenance personnel to obtain keys to gain access to locked areas such as engine generator buildings, power vaults, substations, etc. Other failures and service interruptions have been caused by construction crews accidently cutting power or control cables to facilities.

(2) Facility outages and delays in restoration of power service caused by the problems outlined above can be minimized by properly trained, competent, on-duty technical maintenance personnel who are familiar with local electrical power systems. They must have the technical knowledge and capability to properly analyze and correct or prevent power system problems.

b. **Federal Energy Regulatory Commission.** Order 6950.11, current edition, takes into consideration the possibility of a power shortage which has been pointed out by the Federal Energy Regulatory Commission and has already affected certain areas of the Nation. The Federal Energy Regulatory Commission has indicated that the electrical power shortage will continue into the next several years. In the event a shortage of electric energy should develop, the following steps may be taken by the power companies:

(1) Make full use of interconnection capacity to deliver additional power to the affected area.

(2) Reduce the use of electricity by the affected power industry itself.

(3) Drop interruptible loads in accordance with provision(s) of contracts.

(4) Request large industrial power users to reduce their nonessential load.

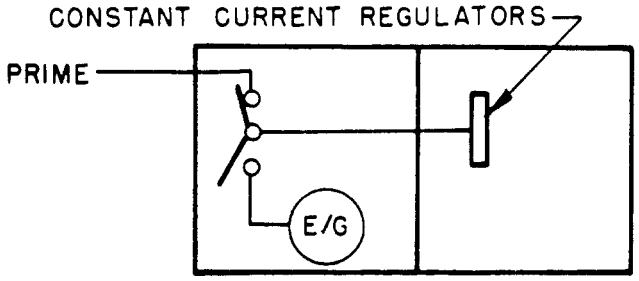
(5) Reduce generated output voltage (not more than 5%).

(6) Curtail system load by selectively dropping loads. The first to be dropped would be industrial users, if this is inadequate, parts of service areas could be cut off for short periods of time alternately. Service to essential public facilities will be maintained.

(7) A further possibility under study is an overall reduction in frequency. Any reduction should not exceed .3 hertz.

APPENDIX 2. CONTINUOUS POWER AIRPORTS

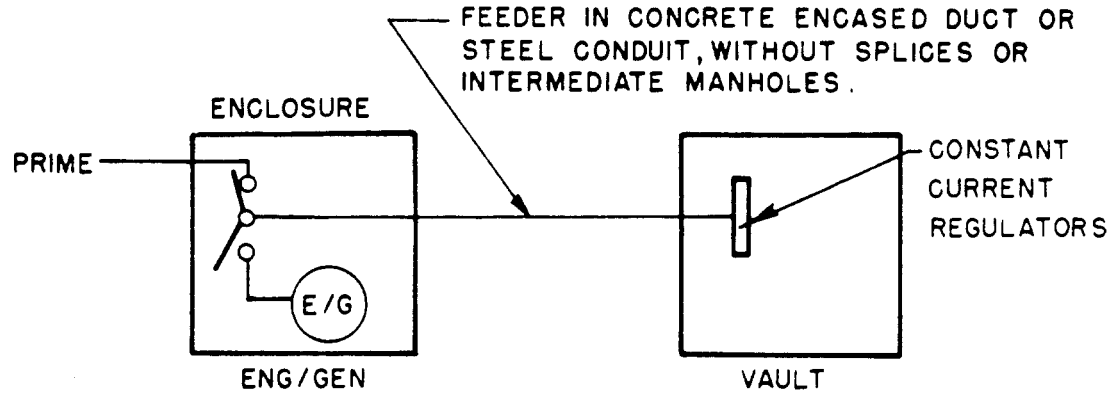
Albuquerque (ABQ)
Andrews AFB (ADW)
Atlanta (ATL)
Baltimore (BAL)
Bismarck (BIS)
Boise (BOI)
Boston (BOS)
Chicago (ORD)
Chicago (MDW)
Charlotte (CLT)
Cincinnati (CVG)
Cleveland (CLE)
Dallas (DAL)
Denver (DEN)
Des Moines (DSM)
Detroit (DTW)
El Paso (ELP)
Great Falls (GTF)
Houston (HOU)
Indianapolis (IND)
Jacksonville (JAX)
Kansas City (MCI)
Los Angeles (LAX)
Memphis (MEM)
Miami (MIA)
Milwaukee (MKE)
Minneapolis (MSP)
Nashville (BNA)
Newark (EWR)
New Orleans (MSY)
New York (JFK)
New York (LGA)
Oklahoma City (OKC)
Omaha (OMA)
Ontario, California (ONT)
Philadelphia (PHL)
Phoenix (PHX)
Pittsburgh (PIT)
Reno (RNO)
Salt Lake City (SLC)
San Antonio (SAT)
San Diego (SAN)
San Francisco (SFO)
St. Louis (STL)
Seattle (SEA)
Tampa (TPA)
Tulsa (TUL)
Washington (DCA)
Washington (IAD)
Wichita (ICT)



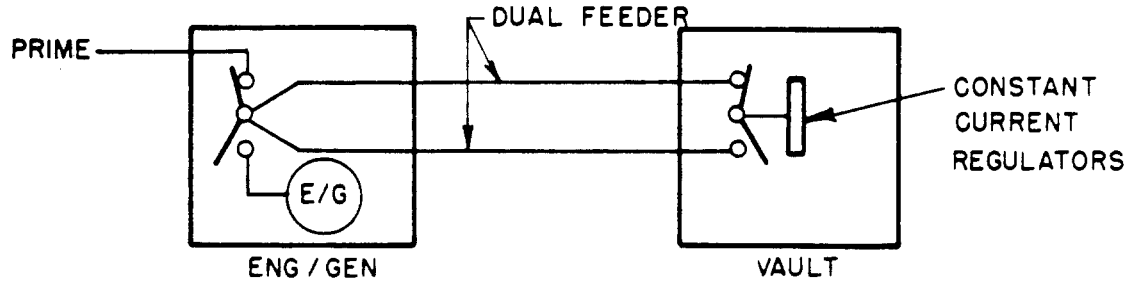
NOTE:

TRANSFORMERS, DISCONNECTS, ISOLATION SWITCHES, PROTECTIVE DEVICES, POWER QUALITY SENSING DEVICES, ETC. NOT SHOWN.

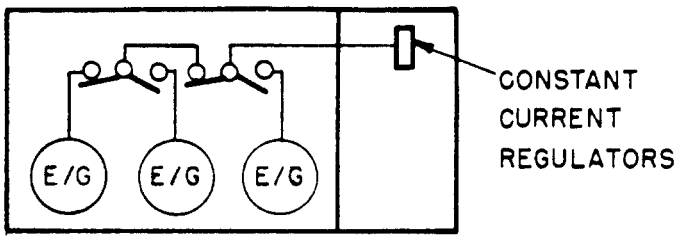
A-1 ENGINE GENERATOR IN VAULT



A-2 ENGINE GENERATOR ADJACENT TO VAULT

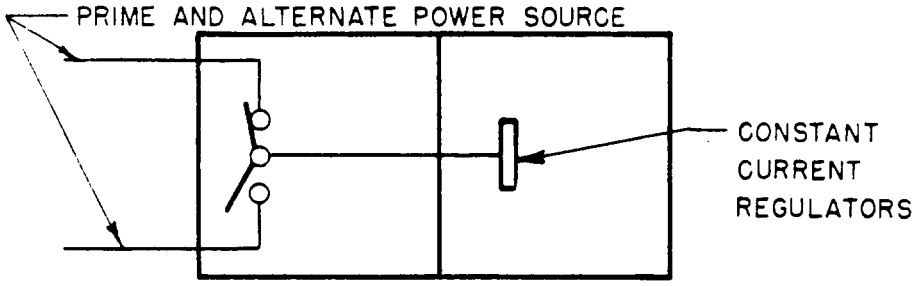


A-3 ENGINE GENERATOR REMOTE FROM VAULT

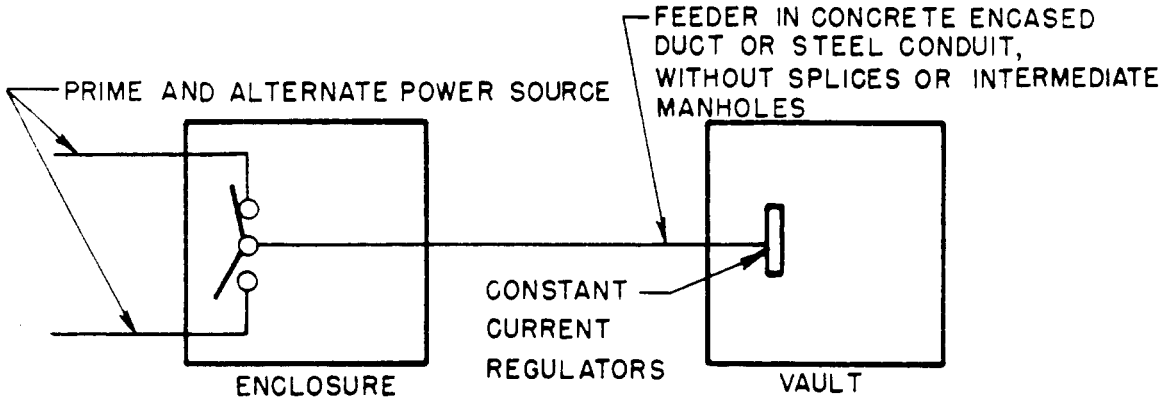


A-4 AGENCY PRIME POWER AT VAULT

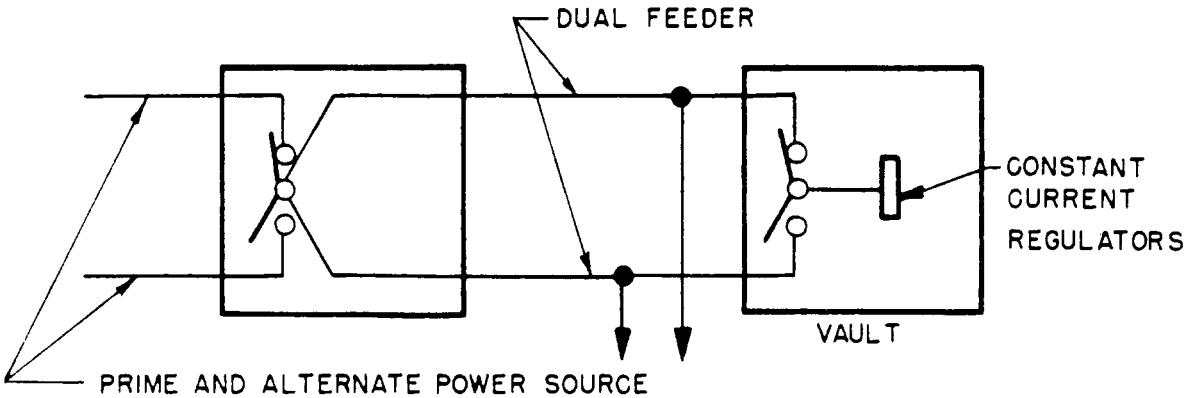
FIGURE 1A. CONFIGURATION "A" ELECTRICAL POWER



B-1 TRANSFER SWITCH AT VAULT

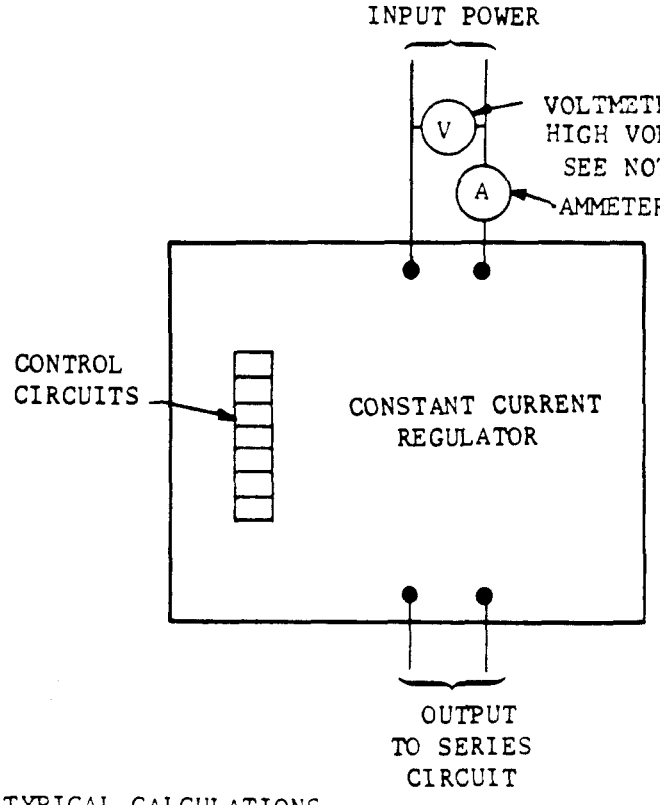


B - 2 TRANSFER SWITCH ADJACENT TO VAULT



B - 3 TRANSFER SWITCH REMOTE FROM VAULT

FIGURE 1B. CONFIGURATION "B" ELECTRICAL POWER



NOTES:

1. Only qualified personnel should take voltage and current measurements.
2. Suitable meters should be used to take voltage and current readings.
3. Power factor correcting capacitors can be obtained in accordance with the regulator manufacturer's recommendations to raise the power factor above 0.7.

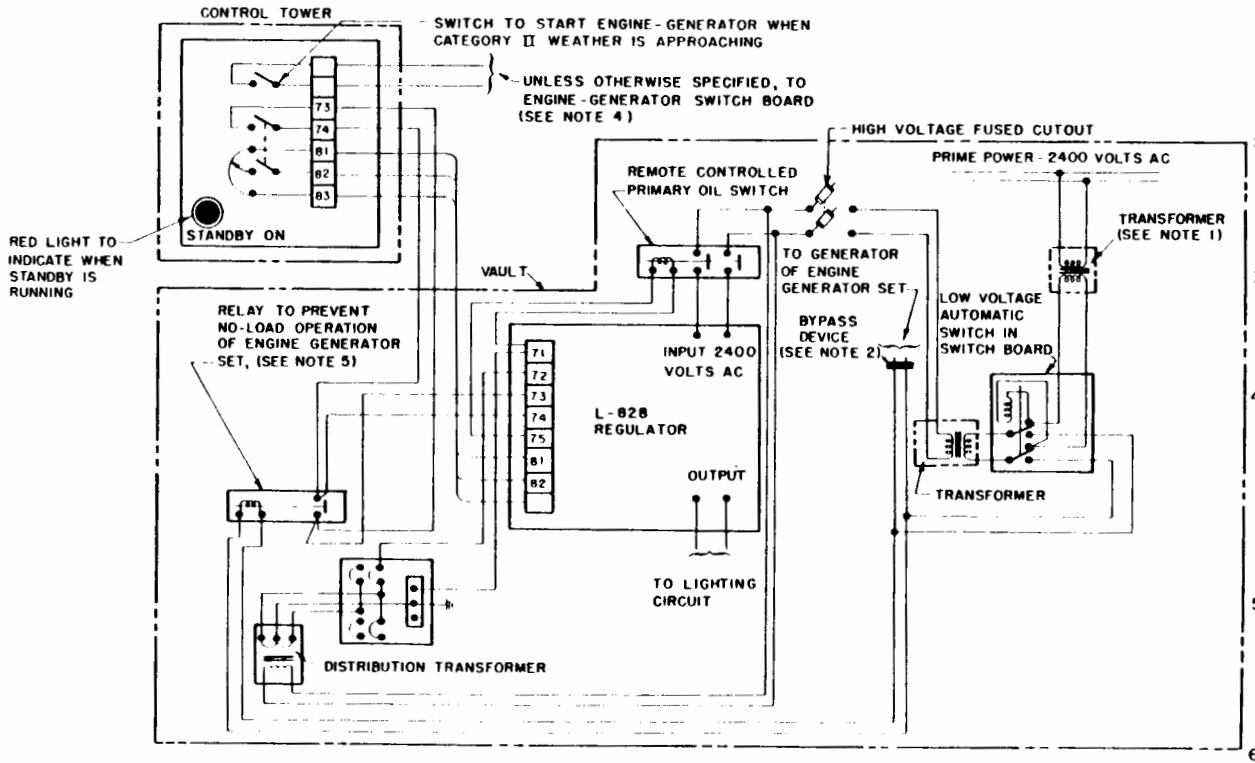
TYPICAL CALCULATIONS

1. Measured KVA
   a. Volts = 2400V
   b. Amperes = 17.0A
   c. KVA Input = $\frac{\text{Volts x Amperes}}{1000}$ $\frac{2400 \times 17.0}{1000}$ = 40.8KVA

2. Calculated KVA
   a. KW = 30
   b. Efficiency = 0.92 (obtain this value from applicable advisory circular for regulator, e.g., Specification L-828)
   c. Power Factor = 0.7 (same as note for b. above)
   d. KVA Input = $\frac{\text{KW}}{\text{Efficiency x Power Factor}}$ $\frac{30}{0.92 \times 0.7}$ = 46.6KVA

3. It is normal for the measured KVA to be less than the calculated KVA, however, the calculated KVA should be used for design purposes. The difference in the values can be caused by the regulator having a higher efficiency and power factor than the values used in the calculations or by the load on the regulator.

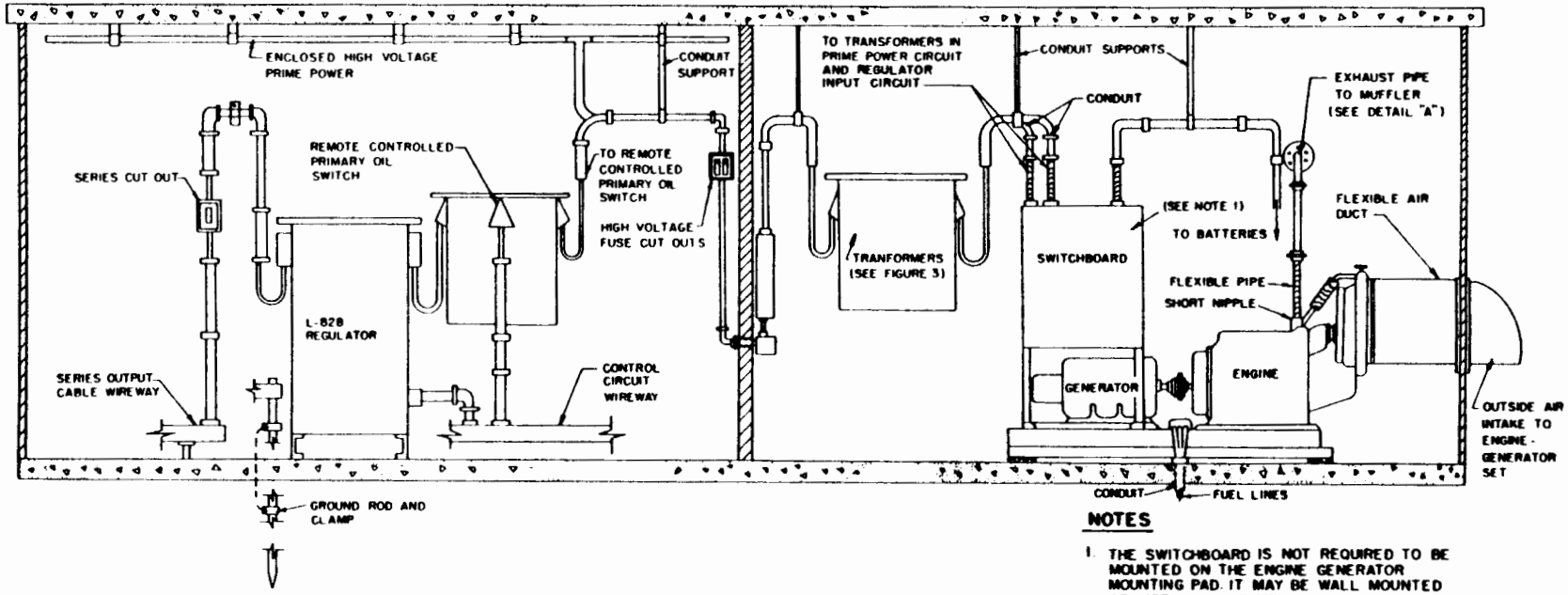
FIGURE 2. TYPICAL KVA INPUT REQUIREMENTS



NOTES:

1. TRANSFORMERS IN THE PRIME POWER AND THE REGULATOR INPUT CIRCUITS ARE NOT REQUIRED IF A SUITABLE HIGH VOLTAGE AUTOMATIC SWITCHING SYSTEM IS USED.
2. PROVIDE A BYPASS SWITCH TO PERMIT RUNNING THE ENGINE GENERATOR ON MANUAL START-STOP TO FACILITATE SERVICING SELECT A BY-PASS SWITCH IN ACCORDANCE WITH FAA-E-2083a.
3. THE RELAY SHOWN IN REGULATOR'S CONTROL CIRCUIT IS NOT REQUIRED IF ENGINE GENERATOR SET IS DESIGNED TO OPERATE UNDER NO-LOAD CONDITIONS.
4. AT CATEGORY II LOCATIONS, USE A REMOTE CONTROLLED SWITCH ON THE L-821 PANEL TO ACTIVATE THE CIRCUIT REQUIRED TO START THE ENGINE-GENERATOR WHEN CATEGORY II WEATHER IS APPROAHING. A RED INDICATOR LIGHT ON THE L-821 PANEL INDICATES "STANDBY ON" WHEN THE ENGINE-GENERATOR SET IS RUNNING.
5. IF HIGH VOLTAGE AND LOW VOLTAGE REGULATORS ARE SUPPLIED BY A SINGLE ENGINE-GENERATOR, PROVIDE THE NECESSARY ACCESSORIES AND SECTIONALIZE REQUIRED LOADS FROM LOADS NOT TO BE SUPPLIED STANDBY POWER.
6. THE SEQUENCE OF OPERATION OF THE SWITCHBOARD AND ENGINE-GENERATOR SET IS IN ACCORANCE WITH MANUFACTURER'S RECOMMENDATIONS

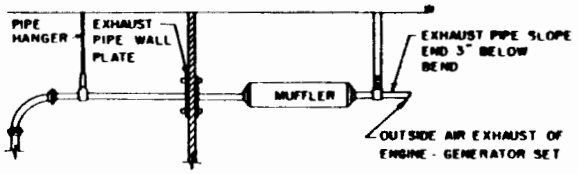
FIGURE 3. TYPICAL WIRING DIAGRAM FOR CONFIGURATION "A" POWER



EQUIPMENT LAYOUT FOR CONFIGURATION "A" POWER

NOTES

1. THE SWITCHBOARD IS NOT REQUIRED TO BE MOUNTED ON THE ENGINE GENERATOR MOUNTING PAD. IT MAY BE WALL MOUNTED OR INSTALLED AT ANY CONVENIENT LOCATION.
2. TYPICAL FLOOR SPACES FOR A 37.5 KVA ENGINE GENERATOR SET WITH AUXILIARY EQUIPMENT ARE 12' WIDTH X 16' LENGTH AND 15' WIDTH X 17' LENGTH, RESPECTIVELY. SPACES FOR UNITS LARGER THAN 75 KVA SHOULD BE IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.



DETAIL "A"

FIGURE 4. TYPICAL EQUIPMENT LAYOUT FOR CONFIGURATION "A" POWER

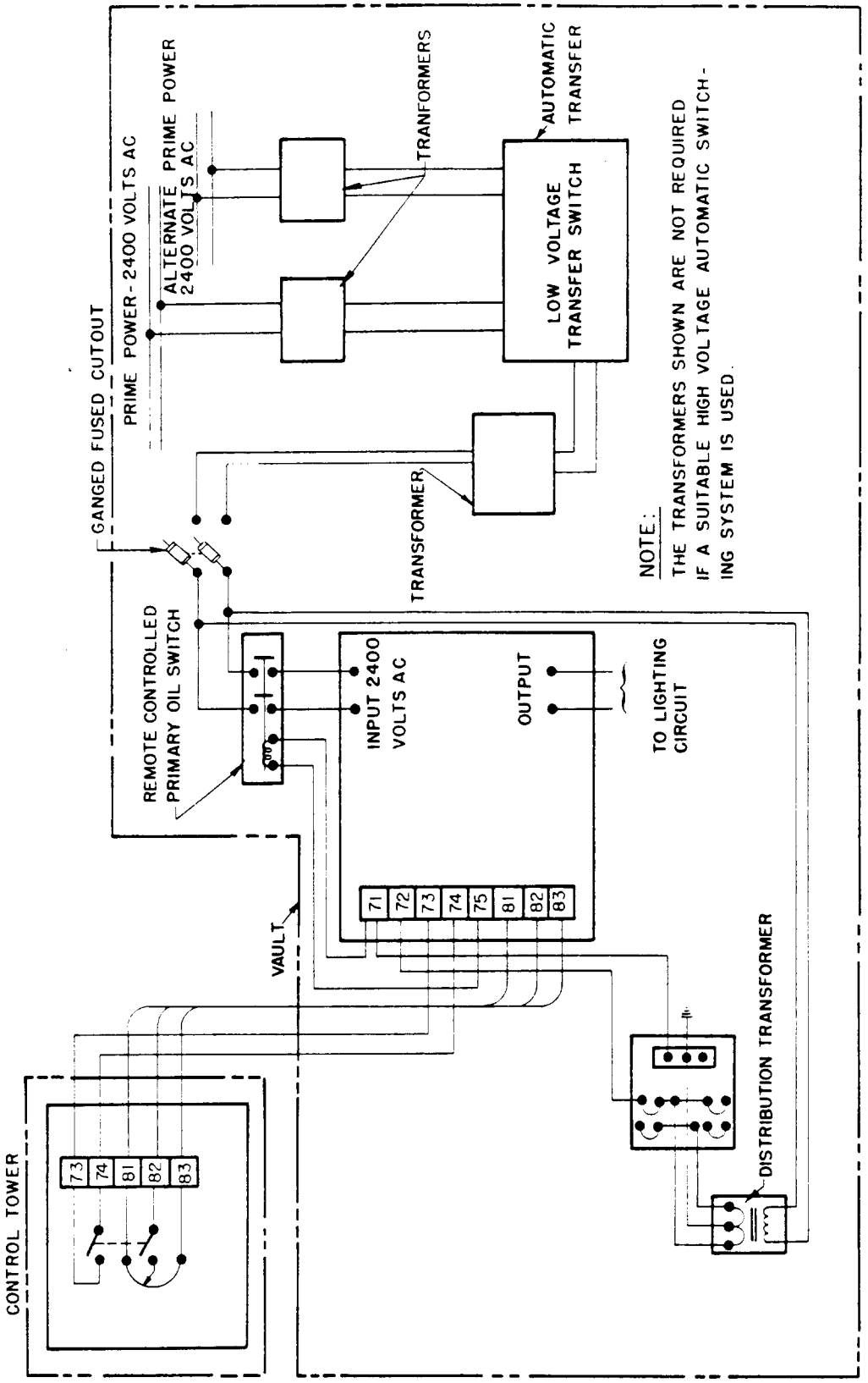


FIGURE 5. TYPICAL WIRING DIAGRAM FOR CONFIGURATION "B" POWER

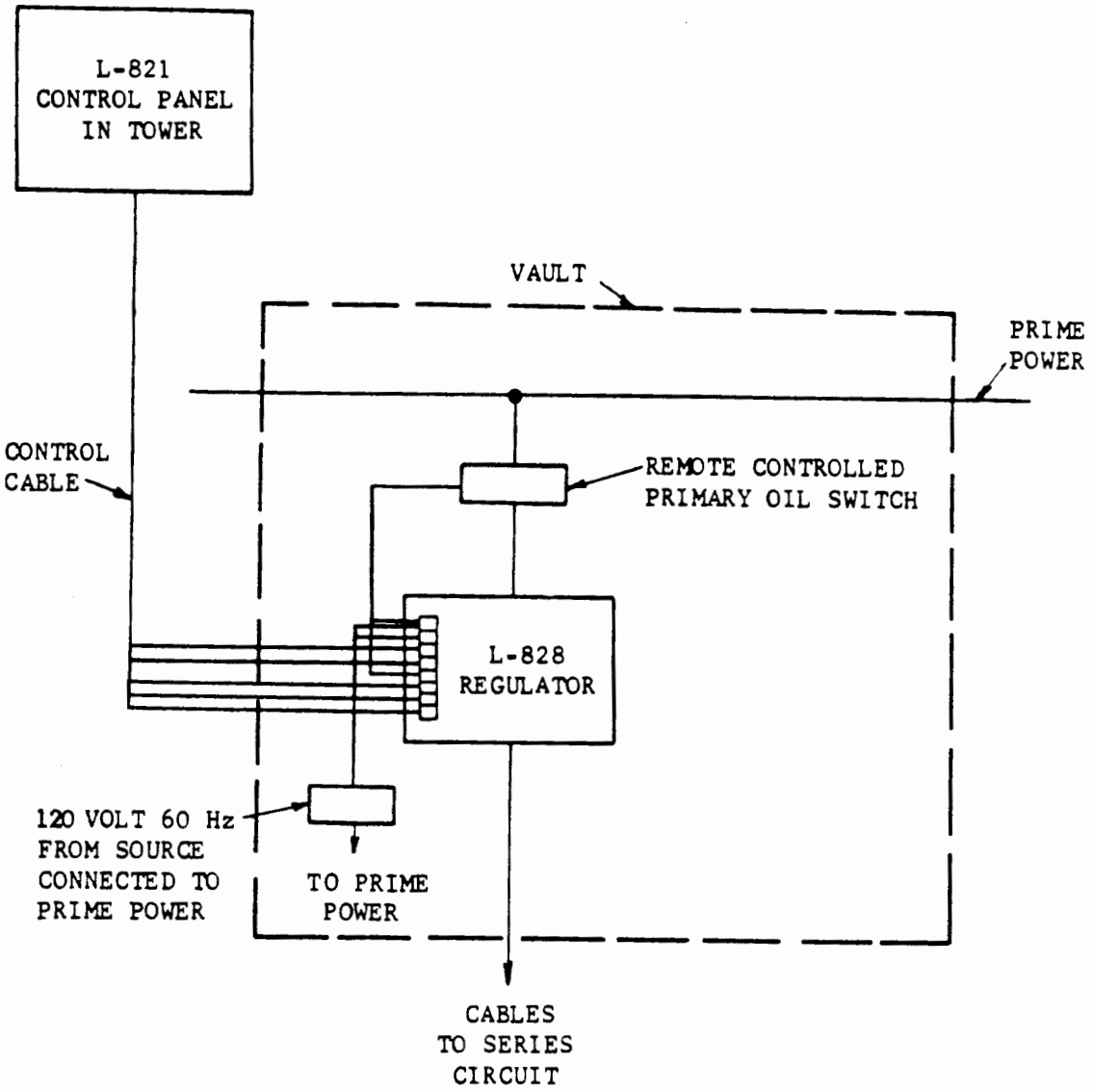


FIGURE 6. TYPICAL WIRING DIAGRAM FOR CONFIGURATION "C" POWER

APPENDIX 3. ENGINE GENERATOR EQUIPMENT PERFORMANCE REQUIREMENTS

1. REFERENCED SPECIFICATION. Specification FAA-E-2204, Engine Generator Sets, 5KW to 300KW, may be used as a guide in selecting standby power equipment. Inasmuch as the requirements for airport lighting are not as rigid as those for supplying power to radar and communication facilities operated and maintained by our agency, the requirements in FAA-E-2204 may be modified as indicated in paragraph 2 below.

2. MODIFICATION TO SPECIFICATION FAA-E-2204, PAGES 3-32:

3. REQUIREMENTS

3.1 Description

Modify to permit transfer switches to be mounted on the wall instead of on the engine generator.

3.2.2 Interchangeability

Delete. Not applicable.

3.2.4 Painting

Modify to eliminate any certain color, to permit use of manufacturers' standard colors.

3.2.7 Spare Parts

Delete

3.2.8 Nameplate and Serial Numbers

Delete requirements for FAA standard nameplate. All other nameplates should be required.

3.2.10 Instruction Book

Delete all reference to Specification FAA-D-2494.

3.3.2 Engine Description

In the second paragraph, this specification states that the "Maximum brake horsepower and speed of the engine shall be as specified in the Classification Table, Figure 1." This Classification Table should be modified to delete the developed horsepower at synchronous speed and permit higher speed on the larger plants.

3.3.10 Governor and Frequency Regulation

Close tolerances on frequency requirements may be relaxed. Standard commercial tolerance is acceptable.

3.4.1 Generator

Eliminate the requirement for parallel operation.

3.4.11 Load Test Jacks

Load test jacks are not required and should be eliminated.

3.4.12 Automatic Power Transfer Equipment

Modify this item to permit the transfer switch and equipment to be mounted on the wall adjacent to the engine generator.

3.4.12.2 Automatic Transfer Switch

Modify to permit wall mounting.

4. INSPECTION AND TESTS

5. PREPARATION FOR DELIVERY

All reference to the tests and inspections shown in 4.1 to 4.2.5 pages 32-42 inclusive, should be deleted. However, the manufacturer should certify that the plant furnished will meet the above tests.

Page 44 - CLASSIFICATION TABLE

Develop HP at Synch. Speed

Delete developed HP at synchronous speed. The manufacturer must supply an engine of sufficient horsepower rating to develop the full KVA rating of the plant.

Maximum Speed RPM

Increase all 1200 RPM to 1800 RPM.